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(54) Hair styling mousse compositions

(57) The invention provides hair styling mousses containing a carboxylated polurethane resin and an optional second hair fixative resin, in an aqueous carrier. The compositions have a low viscosity, and can be ap-

plied as a pump spray or as an aerosol, to generate a consumer-acceptable foam and to hold the hair and impart excellent hair style creation, conditioning, and hair set retention properties to treated hair.

EP 0 838 211 A1

Description

The present invention relates to hair styling mousse compositions that are applied to the hair to shape, style and condition the hair. In particular, the present invention relates to hair styling mousse compositions comprising a carboxylated polyurethane resin, an optional second hair fixative resin, and a carrier comprising water. The mousse compositions impart excellent hair style creation, detangling and style retention properties to treated hair, and are washable from treated hair. Advantageously, it is not essential to incorporate foaming surfactants in the mousse compositions of the invention.

BACKGROUND OF THE INVENTION AND PRIOR ART

Hair styling mousses are a convenient, easy-to-use form of hair styling composition. Typically, the hair styling mousse is applied from an aerosol container, or a non-aerosol pump spray having a foam actuator. When dispensed from the container, the mousse forms a foamy material resembling a shaving cream.

The foam generated by the mousse is attributable to foaming surfactants present in the composition. As used herein, a "foaming surfactant" is an organic compound having an HLB (hydrophilic-lipophilic balance) value of at least about 6, e.g. about 6 to 25. Typically the foam is a fast breaking foam such that the mousse is easily and uniformly rubbed onto damp or dry hair.

To date, all mousse compositions contain a foaming surfactant to generate a foam.

The presence of a foaming surfactant, however, can adversely affect the treated hair, since it can increase the tendency of hair to absorb moisture. In addition, the surfactant can adversely affect the ability of the styling polymers present in the mousse to form a hard, uniform sheath around hair shafts.

Both the above factors can decrease hair set retention.

The use of resins, or polymers, in hair styling compositions such as hair styling mousses is well known. The resins typically used for these purposes are linear vinyl (e.g., an alkyl vinyl ether) or acrylic (e.g. an alkyl acrylate) polymers prepared by copolymerising two or more monomers in a free radical polymerisation reaction. The vinyl and acrylic-based resins are often used in relatively high concentrations in a hair styling composition to fix the hair in a particular configuration and to provide good hair set retention.

However, at high concentrations, the vinyl and acrylic-based resins exhibit disadvantages that adversely affect the hair, such as poor combing, poor feel, and excessive stiffness, crust and flaking. They are also incompatible with high water content systems - when incorporated in such systems they are prone to slow drying and tacky feel on the hair.

Primarily these resins were designed for anhydrous alcohol hair spray compositions. The disadvantages attributed to conventional vinyl and acrylic resins led investigators to search for new hair fixative resins that overcome these disadvantages. EP 0 619 111 A1 describes low VOC spray hair fixative compositions that are prepared from polyurethanes containing pendant free carboxyl groups. The polyurethane resins of EP 0 619 111 A1, however, require neutralisation with a base to make the polyurethane soluble in water or in a mixture of water and a polar organic solvent. Furthermore, there is no disclosure in EP 0 619 111 A1 of any mousse-form hair fixative compositions.

SUMMARY OF THE INVENTION

The present invention provides a hair styling mousse composition comprising:

from 0.25% to 6% by weight of a carboxylated polyurethane resin. ✓

optionally, up to 6% by weight of a second hair fixative resin. and ✓

the % to 99.5% by weight of a carrier comprising water. ✓

because mousse compositions may be applied to the hair as a small-bubbled foam, and after rubbing onto styling hair set retention and soft, natural feel to treated hair, and provide superior hairstyle retention at being the hair styling mousses also detangle and condition the hair. Such results are unexpected In addition, the resins are hydrophobic. In contrast, the carboxylated polyurethane resins used in hair either from are hydrophilic, yet are adhesive to the hair and impart a soft, natural feel without a foaming surfactant is not an essential ingredient with respect to generating a foam composition

DETAILED DESCRIPTION AND PREFERRED EMBODIMENTSCarboxylated Polyurethane Resin

5 The hair styling mousses of the present invention comprise about 0.25% to about 6%, preferably 0.5% to 5%, most preferably 1% to 5%, by weight of the composition, of a carboxylated polyurethane resin.

The carboxylated polyurethane resins are linear, hydroxyl-terminated copolymers having pendant carboxyl groups. They may be ethoxylated and/or propoxylated at least at one terminal end.

10 The carboxyl group can be a carboxylic acid group or an ester group, wherein the alkyl moiety of the ester group contains one to three carbon atoms.

The carboxylated polyurethane resin can also be a copolymer of polyvinylpyrrolidone and a polyurethane, having a CTFA designation PVP/polycarbamyl polyglycol ester.

The carboxylated polyurethane resins are soft and flexible, and typically have a melting point of about 40°C to about 120°C, preferably from 60°C to 100°C, most preferably from 70°C to 90°C.

15 Advantageously, the carboxylated polyurethane resins in the styling mousses of the invention can be solubilized in water, or in a hydroalcoholic solution, in the absence of a base. Therefore, neutralisation with a base is not required to provide a useful hair styling mousse.

20 The carboxylated polyurethane resins also have properties which make them suitable for use in hair styling mousse compositions. For example, the carboxylated polyurethane resins are (a) capable of generating a foam, (b) sprayable, (c) soluble in water and hydroalcoholic solutions, (d) propellant tolerant, and (e) fast drying. The polyurethane resins also exhibit good wet combing properties, and are washable from the hair.

A suitable carboxylated polyurethane resin for incorporation into the hair styling mousse of the invention comprises a reaction product of:

25 ✓ (i) a diisocyanate,

✓ (ii) an alkylene glycol or triol, and/or (iii) a diol component comprising a polymeric dihydroxy-terminated oligomer,

(iv) water, and

30 (v) a 2,2-di-(hydroxymethyl)-alkanoic acid.

An amine, such as diglycolamine, can be substituted for at least a portion of the water in the reaction mixture.

35 ✓ The diisocyanate component (i) can be an aliphatic or an aromatic diisocyanate, or a mixture thereof. An aliphatic diisocyanate is preferred.

Exemplary diisocyanates (i) include:

40 trimethylhexamethylene diisocyanate, isophorone diisocyanate, decamethylene-1, 10-diisocyanate, cyclohexane-1,2-diisocyanate, methylene bis(cyclohexyl-4-isocyanate), toluene-1,4-diisocyanate, toluene-2,6-diisocyanate, diphenylmethane-4,4'-diisocyanate, 3,3'-dimethyldiphenylmethane-4,4'-diisocyanate, m-phenylene diisocyanate, p-phenylene diisocyanate, chlorophenylene diisocyanate, hexamethylene-1,6-diisocyanate, tetramethylene-1,4-diisocyanate, cyclohexane-1,4-diisocyanate, naphthalene-1,5-diisocyanate, 1-methoxyphenyl-2,4-diisocyanate, 4,4'-biphenylene diisocyanate, 3,3'-dimethoxy-4,4'-biphenyl diisocyanate, 3,3'-dimethyl-4,4'-biphenyl diisocyanate, 3,3'-dichlorophenyl-4,4'-diisocyanate, 2,2',5,5'-tetrachlorodiphenyl-4,4'-diisocyanate, trimethylhexamethylene diisocyanate, m-xylene diisocyanate, and mixtures thereof.

45 Suitable alkylene glycols or triols (ii) include low molecular weight glycols or triols, wherein the glycol or triol has at least two hydroxyl groups and a molecular weight up to about 200, for example ethylene glycol, diethylene glycol, propylene glycol, glycerol, hexylene glycol, cyclohexanediol, cyclohexanedimethanol, 1,4-butanediol, tripropylene glycol, triethylene glycol, dipropylene glycol, or mixtures thereof. These can be interacted with diisocyanate to provide a polyurethane.

50 ✓ Suitable diol components (iii) comprising a polymeric dihydroxy-terminated oligomer include polyoxyalkylene glycols having a molecular weight of about 200 to 20,000. Exemplary oligomers include polypropylene glycols, polyethylene glycols, ethylene glycol-propylene glycol copolymers, polybutylene glycols, and mixtures thereof. These can be interacted with diisocyanate to provide a polyurethane.

55 Preferably, a diisocyanate is interacted both with a low molecular weight diol or triol and with a polymeric dihydroxy-terminated oligomer to provide a polyurethane for use in the invention.

The carboxylated polyurethane resin contains pendant carboxyl groups and is hydrophilic. Preferably, the number of carboxyl groups is sufficient to give the carboxylated polyurethane resin an acid value of at least about 7 mg KOH/g resin (milligrams potassium hydroxide per gram of resin). Since the hair styling mousses of the invention then exhibit

improved washability from the hair. Preferably the acid value of the carboxylated polyurethane resin in styling mousses of the invention is from about 7 to about 50 mg KOH/g resin.

✓ Examples of useful carboxylated polyurethanes are disclosed in Gould et al, US Patent No. 5,000,955. Other useful hydrophilic polyurethanes are disclosed in US Patent Nos. 3,822,238; 4,156,066; 4,156,067; 4,255,550; and 4,743,673.

5 One embodiment of the present invention is described as follows:

In this embodiment, the carboxylated polyurethane resin comprises a reaction product of:

a diol component comprising a polyoxyalkylene diol, preferably a polyoxyethylene diol having a number average molecular weight (M_n) of about 200 to about 20,000, a polyoxypropylene diol having an M_n of about 200 to about 2500, a block copolymer of ethylene oxide and propylene oxide having an M_n of about 1,000 to about 9,000, or a polyoxytetramethylene diol having an M_n of about 200 to about 4,000; about 0.01% to about 10% by weight of a low molecular weight alkylene glycol selected from the group consisting of ethylene glycol, propylene glycol, 2-ethyl-1,3-hexanediol, tripropylene glycol, triethylene glycol, 2,4-pentanediol, 2-methyl-1,3-propanediol, 2-methyl-1,3-pentanediol, cyclohexanediol, cyclohexanedimethanol, dipropylene glycol, diethylene glycol, and mixtures thereof; an organic diisocyanate; a 2,2-di-(hydroxymethyl)alkanoic acid; and water in an amount of about 0.05% to about 0.5% by weight of the reaction mixture, wherein the NCO/OH ratio (i.e., the R-value) is about 0.5 to about 1, and preferably about 0.6 to about 0.98. Most preferably, the R-value is about 0.65 to about 0.85.

In this embodiment, an amine can be used in the above reaction mixture for at least a portion of the water. The amine can be added to the reaction mixture in an amount of about 0.01% to about 0.8% by weight amine, preferably about 0.02% to about 0.5% amine to about 0.01% to about 0.2% water in the reaction mixture. Amines that can be used in the reaction are ethylenediamine, propylenediamine, monoethanolamine, diglycolamine, and JEFFAMINE D1-230, D-400, D-2000, D-4000, ED-0600, ED-900, or ED-2001. The hydroxylamines and the JEFFAMINE products are manufactured by Texaco Chemical Company. Preferably, the amine is a hydroxylamine, and most preferably the amine is monoethanolamine and/or diglycolamine.

The polyoxyethylene diols are available from Union Carbide Corporation under the trademark CARBOWAX, such as CARBOWAX® 1450 AND CARBOWAX® 8000 wherein the number represents number average molecular weight. The polyoxypropylene diols (PPG) are available from various sources, such as the PPG series of ARCO NIAX® PPG 1025, PPG 425, PPG 725, PPG 1225, and PPG 2025, and as R2134 (2200) and R2135 (4400), wherein the number represents number average molecular weight. Triols are also available from ARCO as NIAX® Polyols 11-34, LG-650, LG-56, LG-166, LHT-28, LHT-240. The polyoxytetramethylene diols are available from E.I. DuPont de Nemours as TERATHANE 600, 1000, 1400, 2000 and 2900. Polyetherpolycarbonate is available from BASF under the tradename polytetrahydrofuran 1000 CD and 2000 CD.

A block polyoxyalkylene polymer also can be used in the reaction referred to above. For example, a propylene oxide terminated block of ethylene glycol manufactured by BASF under the tradename PLURONIC R and a ethylene oxide terminated block of propylene glycol manufactured by BASF under the tradename of PLURONIC can be used for the polyoxyalkylene in the reaction. Examples of the block copolymers of the sequential addition of ethylene oxide and propylene oxide to ethylene diamine are made by BASF under the tradename of PLURONIC, such as PLURONIC F68, F64, F127, L35, L92, L82, 17R2, and 25R2.

Preferably, the polyoxyalkylene diol used in forming the polyurethane resin of this embodiment is polyoxyethylene diol. The blends of polyoxyalkylene diols contain at least about 10% polyoxyethylene diol, preferably, at least 20% polyoxyethylene diol, and most preferably, at least 25% polyoxyethylene diol, by weight.

The amount of polyoxyalkylene diol having an M_n of 200 to 20,000 in the polyurethane resin can vary from about 10% to about 90%, preferably about 30% to about 90%, and most preferably about 40% to about 90%, by weight, and the number average molecular weight (M_n) of the polyoxyalkylene diol can vary from about 200 to about 20,000, preferably from about 400 to about 12,000, and more preferably from about 800 to about 10,000.

The alkylene glycols are commercially available from several sources. For example, propylene glycol can be purchased from Aldrich Chemical Company as 1,2-propanediol. The amount of the alkylene glycol component in the polyurethane resin can be about 0.01% to about 20%, preferably about 0.05% to about 15%, more preferably about 0.1% to about 12%, still more preferably about 0.5% to about 10%, and most preferably about 1% to about 8%, by weight of the reaction mixture.

An especially preferred diisocyanate for this embodiment is methylene bis(cyclohexyl-4-isocyanate). Other examples of preferred diisocyanates are trimethyl hexamethylene diisocyanate, isophorone diisocyanate, tetramethylene diisocyanate, hexamethylene diisocyanate, trimethylene diisocyanate, trimethylhexamethylene diisocyanate, cyclohexyl-1,2-diisocyanate, and cyclohexyl-1,4-diisocyanate. Also suitable are the isocyanate equivalents which form urethane linkages, exemplified by nitrile carbonates, such as adiponitrile carbonate disclosed in U.S. Patent No. 4,810,543. The amount of diisocyanate varies from about 3% to about 80%, such as from about 4% to about 70%, preferably from about 5% to about 60%, more preferably from about 6% to about 55%, and most preferably from about 6.5% to about 50%, by weight. The polyurethane resins are prepared by reacting the polyoxyalkylene diols with the diisocyanates.

The amount of water in the reaction mixture according to this embodiment is about 0.05% to about 0.5%, and more preferably about 0.1% to about 0.45%, by weight, of the reaction mixture.

The carboxylated polyurethane resin of the above described embodiment contains polyoxyalkylene units, i.e. soft segments, and/or alkylene units, i.e. hard segments, connected by urethane linkages. Preferably, the carboxylated polyurethane resin contains soft and hard segments. Also incorporated into the polymer chain is a small amount of diol having a pendant carboxyl group. The polymer chain further contains urea linkages resulting from a reaction between water and isocyanate groups, which modify the hair styling properties of the polyurethane.

Polyoxyethylene soft segments of the polyurethane resin impart hydrophilicity to the polyurethane. Soft segments derived from polyoxypropylene and polyoxytetramethylene diols provide a softer, but less hydrophilic, polyurethane. Hydrophilic polyurethane resins having improved strength and superior adhesive properties can be formed by using combinations of polyoxyalkylene diols.

Another embodiment of the present invention is described as follows:

In this embodiment, the carboxylated polyurethane resin comprises a reaction product of:

a) a diol having a major portion of a polyoxyethylene diol having an M_n of 6,000 to 10,000 and a minor portion of a polyoxypropylene diol having an M_n of about 1,000 to about 3,500 or a polyoxyethylene diol having an M_n of about 200 to about 2,000; b) an alkylene glycol; c) a diisocyanate; d) water in an amount of about 0.05% to about 0.5% by weight of the reaction mixture; and e) a 2,2-di(hydroxymethyl)-alkanoic acid, and an equivalent mole weight ratio of NCO to OH of the water, diol and glycol of about 0.5 to about 1. Preferably, at least 45% of the polyoxyethylene glycol of M_n about 8000, more preferably at least about 55%, still more preferably at least about 65%, and most preferably at least 75%, by weight, is used in the total reaction mixture. The amount of the lower molecular weight polyoxyethylene diol having an M_n of about 200 to about 2,000 is about 1% to about 15% and preferably from about 2% to about 10%, by weight of the reaction mixture. Preferably, the alkylene glycol is diethylene glycol, cyclohexanedimethanol, dipropylene glycol, or a mixture thereof.

The 2,2-di(hydroxymethyl)alkanoic acid preferably is dimethylolpropionic acid. The amount of dimethylolpropionic acid is about 1% to about 8%, preferably about 1.5% to about 7%, and most preferably about 2% to about 6% by weight of the reaction mixture. The final product has an acid value of at least about 7 mg KOH/g resin, most preferably an acid value of about 7 to about 50 mg KOH/g resin. The sum of all ingredients, including the diols, glycols, water and diisocyanate in the above reaction mixture totals 100% by weight.

In this embodiment, an amine can be used in place of a portion of the water in the above reaction mixture. An amount of about 0.15% to about 0.6% amine, based on diglycolamine, is used with about 0.06% to about 0.5% of water, more preferably about 0.1% to about 0.4% of water, and most preferably of about 0.15% to about 0.3% of water.

The preferred diol according to this embodiment is a polyoxyethylene diol, preferably a polyoxyethylene diol of M_n about 200 to about 5,000. The preferred water level is about 0.1% to about 0.45%, and most preferably about 0.15% to about 0.4% by weight.

The ratio of NCO to OH groups from the diol, alkylene glycol, amines and water (i.e., the R-value) in the reaction mixture is about 0.5 to about 1, preferably 0.6 to 0.98, and most preferably 0.65 to 0.85. The weight average molecular weight (M_w) of the carboxylated polyurethane resin is about 10,000 to about 150,000, preferably 15,000 to 100,000, and most preferably 15,000 to 75,000.

The carboxylated polyurethane resins of the above embodiment are especially useful in hair styling mousse compositions because the polyurethane resins are soluble in dilute neutral to basic aqueous solutions, and in ethanol/water mixtures, to form low viscosity solutions. Solutions of the polyurethane resins also exhibit improved sprayability, the ability to generate foam in the absence of a foaming surfactant, improved feel of sprayed hair, low flaking and crust, and improved hair set retention. These and other advantageous properties are observed when the carboxylated polyurethane resins are admixed with an optional second hair fixative resin, e.g., increased water solubility of the second hair fixative resin, improved feel of treated hair, and reduced crust and flaking.

For hair styling mousses according to the present invention, the hydrophilicity of the polyurethane resin is an unexpected important property in combination with other desirable properties, such as washability. Conventional hair fixative resins are hydrophobic materials that impart a stiff feel to treated hair. The polyurethane resins in styling mousses of the present invention are hydrophilic materials that give hair a soft, natural feel, yet are adhesive to the hair and impart excellent hair set retention.

It has also been found that the hair styling properties of the polyurethane resin in styling mousses of the invention can be affected by small changes in the amount of water, the ratio of NCO/OH, and the amount of the di(hydroxymethyl)alkanoic acid in the reaction mixture.

Accordingly, in a further embodiment of the invention, the weight average molecular weight of the carboxylated polyurethane resins can be decreased or increased by modifying the amount of water in the reaction mixture within a predetermined range. The above-described polyurethane resins have an M_w of about 10,000 to about 150,000, and preferably about 15,000 to about 100,000; and a kinematic viscosity at 3 wt.% in 55/42 ethanol/water (by weight) of about 1 to about 40 centistokes (cs), formed from a range of water of about 0.1% to about 0.3% by weight of the reaction

mixture, an NCO/OH ratio (i.e., R-value) of about 0.75 to about 0.95, and about 1% to about 2.7% by weight of the reaction mixture of dimethylolpropionic acid.

A polyurethane having an M_w of about 55,000 to about 150,000 can be formed using 0.3% to about 0.45% by weight water, a preferred NCO/OH ratio of about 0.75 to about 0.98, and about 1% to about 2.7% by weight dimethylolpropionic acid.

A polyurethane resin having an M_w of less than about 25,000 can be formed using a water level of about 0.25% to about 0.4% by weight of the reaction mixture, a ratio of NCO/OH about 0.60 to about 0.75, and a range of dimethylolpropionic acid of about 3% to about 6.5% by weight of the reaction mixture. The polyurethane resin has a kinematic viscosity at 3 wt.% in a 55/42 ethanol/water solution (by weight) of about 1 to about 10 cs. These polyurethane resins are useful as hair styling aids and form low viscosity solutions in water and hydroalcoholic solutions.

Polyurethane resins prepared using about 0.1% to about 0.4% by weight water in the reaction mixture, and an NCO/OH ratio of about 0.55 to about 0.95, preferably from about 0.6 to about 0.7, impart a set retention at 30 minutes of about 80% to about 90%. An amount of water of about 0.15% to about 0.45% by weight in the reaction mixture and an NCO/OH ratio of about 0.6 to about 0.92, preferably from about 0.7 to about 0.85, can be used to provide polyurethane resins imparting a set retention of about 85% to about 98% at 30 minutes.

Alternatively, small amounts of diglycolamine can be substituted for the water in the reaction mixture, e.g., about 0.02% to about 1%, preferably from about 0.03% to about 0.75%, more preferably from about 0.04% to about 0.5%, and most preferably from 0.05% to about 0.4% by weight diglycolamine can be used in the reaction mixture.

The alkylene glycol used in the above-described embodiment can be, for example, ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, cyclohexanediol, 1,4-butanediol, cyclohexanedimethanol, tripropylene glycol, or triethylene glycol; preferably diethylene glycol, cyclohexanedimethanol, or dipropylene glycol; and most preferably diethylene glycol. The amount of the alkylene glycol (hard segments) in the reaction mixture is about 0.01% to about 20%, such as about 0.05% to about 15%, preferably about 0.1% to about 12%, more preferably about 0.5% to about 10%, and most preferably about 1% to about 5%, by weight.

In each of the above described embodiments, the polyurethane-forming reaction is catalysed by known catalysts. Tin-containing catalysts, such as tin salts or organotin esters, for example, stannous octoate and dibutyltin dilaurate, or tertiary amines, such as triethylene diamine and N,N,N',N'-tetramethyl-1,3-butane diamine, are preferred. The catalyst is used in an amount effective to catalyse the reaction, i.e., about .001 to 1 weight percent of the total weight of the reactive components. Reaction temperature is about 40°C to about 120°C.

In each of the above described embodiments, the carboxylated polyurethane resin contained carboxylic acid groups. However, carboxylated polyurethane resins wherein carboxylic acid groups are converted to ester groups with an alcohol having one to three carbon atoms also can be utilised as the carboxylated polyurethane resin in styling mousses of the present invention.

Other useful carboxylated polyurethane resins are PVP/polycarbamyl polyglycol esters, which are copolymers of polyvinylpyrrolidone and polyurethane. These carboxylated polyurethane resins are available commercially from Phoenix Chemical, Inc., Somerville, NJ, as PECOGEL A-12, PECOGEL H-12, PECOGEL H-115 and PECOGEL H-1220.

Second Hair Fixative Resin

In addition to the carboxylated polyurethane resin, the hair styling mousse may optionally contain up to about 6%, preferably from 0.25% to 5%, most preferably from 1% to 5%, by weight of the composition of a second hair fixative resin.

Preferably, the weight ratio of optional second hair fixative resin to carboxylated polyurethane resin in hair styling mousses of the invention is about one or less.

The second hair fixative resin can be a nonionic, cationic, amphoteric or anionic resin, or a mixture of any of these. Advantageously the carboxylated polyurethane resin is compatible with each of these classes of resins.

The presence of a second hair fixative resin in hair styling mousses of the present invention can, advantageously, reduce flaking attributed to the carboxylated polyurethane resins. In particular, the optional second hair fixative resin can impart a desired and predetermined degree of stiffness to the hair. The carboxylated polyurethane resin per se provides an elastic, flexible film on the hair, which gives the hair a soft, natural feel. However, consumers often equate a good hair setting composition with a degree of hair stiffness. The present hair styling mousses, therefore, impart the desired stiffness to the hair, while further providing the benefits attributable to the polyurethane resin, such as conditioning, good style retention and good hair feel. By a judicious selection of the amount and nature of the second hair fixative resin, the hair styling mousses of the invention can be designed to impart any desired feel to treated hair.

Examples of anionic hair fixative resins are copolymers of vinyl acetate and crotonic acid, terpolymers of vinyl acetate, crotonic acid and a vinyl ester of an alpha-branched saturated aliphatic monocarboxylic acid such as vinyl neodecanoate; copolymers of methyl vinyl ether and maleic anhydride (molar ratio about 1:1) wherein such copolymers are 50% esterified with a saturated alcohol containing from 1 to 4 carbon atoms such as ethanol or butanol; and acrylic

copolymers, terpolymers, etc., containing acrylic acid or methacrylic acid as the anionic radical-containing moiety and esters of acrylic or methacrylic acid with one or more saturated alcohols having from 1 to 22 carbon atoms such as methyl methacrylate, ethyl acrylate, ethyl methacrylate, n-butyl acrylate, t-butyl acrylate, t-butyl methacrylate, n-butyl methacrylate, n-hexyl acrylate, n-octyl acrylate, lauryl methacrylate and behenyl acrylate, glycols having from 1 to 6 carbon atoms such as hydroxypropyl methacrylate and hydroxyethyl acrylate, styrene, vinyl caprolactam, vinyl acetate, acrylamide, alkyl acrylamides and methacrylamides having 1 to 8 carbon atoms in the alkyl group such as methacrylamide, t-butyl acrylamide and n-octyl acrylamide, and other compatible unsaturated monomers. One specific example is the emulsion polymerised terpolymer of methacrylic acid, n-butyl acrylate and ethyl acrylate (e.g., in a weight percent ratio of 31:42:27, respectively). Another specific example is Ultrahold® 8 (CTFA-Cosmetic, Toiletries and Fragrance Association designation of Acrylate/Acrylamide Copolymer).

Amphoteric polymers which can contain cationic groups derived from monomers such as t-butyl aminoethyl methacrylate as well as carboxyl groups derived from monomers such as acrylic acid or methacrylic acid can also be used in the styling mousses of the invention. One specific example of an amphoteric hairspray resin is Amphomer® sold by the National Starch and Chemical Corporation.

Examples of nonionic hair fixative resins are homopolymers of N-vinylpyrrolidone and copolymers of N-vinylpyrrolidone with compatible nonionic monomers such as vinyl acetate and terpolymers of ethyl acrylate, butyl methacrylate and methyl methacrylate. Nonionic polymers containing N-vinylpyrrolidone in various weight average molecular weights are available commercially from ISP Corporation such as homopolymers of N-vinylpyrrolidone having an average molecular weight of about 630,000 sold by ISP (formerly GAF Corporation) under the tradename PVP K-90 and those having an average molecular weight of about 1,000,000 sold under the trademark of PVP K-120.

Examples of cationic hair fixative resins are copolymers of amino-functional acrylate monomers such as lower alkyl aminoalkyl acrylate or methacrylate monomers such as dimethylaminoethyl methacrylate with compatible monomers such as N-vinylpyrrolidone, vinyl caprolactam, or alkyl methacrylates such as methyl methacrylate and ethyl methacrylate and alkyl acrylates such as ethyl acrylate and n-butyl acrylate.

Cationic polymers containing N-vinylpyrrolidone are commercially available from ISP Corporation such as those sold under the trademarks of Copolymer 845 and Copolymer 937 (copolymers of N-vinylpyrrolidone and t-butylaminoethyl methacrylate of average molecular weight about 1,000,000) and Gafquat® 755 and 755N (quaternary ammonium polymers formed by the reaction of dimethyl sulphate and a copolymer of N-vinylpyrrolidone and dimethylaminoethyl methacrylate of average molecular weight about 1,000,000).

For hair styling mousse compositions, the kinematic viscosity of a solution of a polyurethane resin and an optional second hair fixative resin having a weight percent of total resin of 3% is less than about 1,000 centistokes (cs), i.e., about 1 to about 1,000 cs, preferably about 500 cs or less, more preferably about 100 cs or less, still more preferably less than about 50 cs, and most preferably less than about 40 cs.

In addition to the carboxylated polyurethane resin and the optional second hair fixative resin, the hair styling mousse compositions of the invention may optionally contain up to 20%, by total weight of the composition, of a lower alcohol, i.e., an alcohol having one to seven carbon atoms. Preferably, the composition contains up to about 10%, by weight, of a lower alcohol. If desired for environmental reasons (e.g. VOC legislation), the amount of lower alcohol may be kept at a minimum, or even omitted from the mousse composition.

If present, the lower alcohol typically used in the hair styling mousse composition is ethanol, although isopropyl alcohol also can be incorporated into the composition. The carboxylated polyurethane resins are readily solubilised in water and in a wide range of hydroalcoholic solutions without the addition of basic neutralizer. This permits, advantageously, a decrease in the amount of, or even total elimination of, alcohol present in the hair styling mousse composition.

Carrier

Hair styling mousses of the invention also include from about 15% to about 99.5% by weight of the composition of a carrier comprising water. The carrier usually comprises up to about 98% water and may include other conventional liquid excipients suitable for personal care compositions, such as humectants, water-soluble or insoluble liquid emollients, organic liquid solvents and the like.

Advantageously, it is not necessary to include a base in the water to neutralise and solubilize the carboxylated polyurethane resin. The carboxylated polyurethane resin also assists in solubilizing the optional second hair fixative resin, and in reducing the viscosity of the hair styling mousse composition.

Product Form

A hair styling mousse composition containing only a polyurethane resin, an optional second hair fixative resin, and water can be applied to the hair as a non-aerosol pump spray. By using a pump capable of introducing air into the pump spray, the mousse composition foams in a manner acceptable to consumers.

The mousse composition can be modified for application as an aerosol spray by incorporating about 3% to about 30%, by weight of the composition, of a propellant. The carboxylated polyurethane resin and optional second hair fixative resin tolerate the propellant gases commonly used in aerosol compositions, such as the alkanes and carbon dioxide.

The optional propellant gas included in the hair styling mousse compositions can be any liquefiable gas conventionally used for aerosol products. Examples of compounds that are suitable for use as propellants are trichlorofluoromethane, dichlorodifluoromethane, dichlorotetrafluoroethane, monochlorodifluoromethane, trichlorotrifluoroethane, dimethyl ether, propane, n-butane and isobutane, either singly or admixed. Water-soluble gases such as dimethyl ether, carbon dioxide, and/or nitrous oxide can also be used to obtain aerosol sprays having reduced flammability.

Water-immiscible, liquified, hydrocarbon and halogenated hydrocarbon gases such as propane, butane and chlorofluorocarbons can be used advantageously to deliver the contents of an aerosol container without the dramatic pressure drops associated with other immiscible gases. The head space left inside the aerosol container is not a factor because the liquified gas sits on top of the aqueous composition and the pressure inside the container is maintained at the vapour pressure of the saturated hydrocarbon vapour.

Other insoluble, compressed gases such as nitrogen, helium, and fully fluorinated oxetanes and oxepanes are also useful to deliver the compositions from aerosol containers. If the propellant, such as dimethyl ether, incorporates a vapour pressure suppressant (e.g., trichloroethane or dichloromethane), the amount of suppressant is included as part of the propellant for weight percentage calculations.

Optional Ingredients

Hair styling mousses of this invention may contain any other ingredient normally used in hair styling mousses. These other ingredients may include emulsifiers or foaming agents, such as anionic, amphoteric and/or nonionic surfactants; nonionic conditioners, such as silicones and hydrocarbons; cationic conditioners, such as cetyl trimethylammonium chloride, behenyl trimethylammonium chloride and stearyl dimethylbenzylammonium chloride; preservatives, colouring agents, chelating agents such as EDTA; antioxidants, thickening agents, such as a gum or cellulose-based thickener; emollients, such as ethers or esters of fatty alcohols, or esters of fatty acids; fragrances, antimicrobials and sunscreens. Each of these ingredients will be present in an amount effective to accomplish its purpose. Generally these optional ingredients are included individually at a level of up to about 5% by weight of the total composition.

Preferably, hair styling mousses of this invention also contain adjuvants suitable for hair care. Generally such ingredients are included individually at a level of up to 2%, preferably up to 1%, by weight of the total composition.

Among suitable hair care adjuvants, are:

(i) natural hair root nutrients, such as amino acids and sugars. Examples of suitable amino acids include arginine, cysteine, glutamine, glutamic acid, isoleucine, leucine, methionine, serine and valine, and/or precursors and derivatives thereof. The amino acids may be added singly, in mixtures, or in the form of peptides, e.g. di- and tripeptides. The amino acids may also be added in the form of a protein hydrolysate, such as a keratin or collagen hydrolysate. Suitable sugars are glucose, dextrose and fructose. These may be added singly or in the form of, e.g. fruit extracts. A particularly preferred combination of natural hair root nutrients for inclusion in compositions of the invention is isoleucine and glucose. A particularly preferred amino acid nutrient is arginine.

(ii) hair fibre benefit agents. Examples are:

- ceramides, for moisturising the fibre and maintaining cuticle integrity. Ceramides are available by extraction from natural sources, or as synthetic ceramides and pseudoceramides. A preferred ceramide is Ceramide II, ex Quest. Mixtures of ceramides may also be suitable, such as Ceramides LS, ex Laboratoires Sérobiologiques.

- fatty acids, for cuticle repair and damage prevention. Examples are branched chain fatty acids such as 18-methyleicosanoic acid, and other homologues of this series, straight chain fatty acids such as stearic, myristic and palmitic acids, and unsaturated fatty acids such as oleic acid, linoleic acid, linolenic acid and arachidonic acid. Particularly preferred are those fatty acids which occur naturally as essential, integral components of the hair fibre, and which therefore may need replenishing due to fibre damage and loss. The fatty acids may be added singly, as mixtures, or in the form of blends derived from extracts of e.g. lanolin.

The hair styling mousse compositions of the present invention are prepared by simply admixing and dissolving the carboxylated polyurethane resin, the optional second hair fixative resin, and any optional ingredients into an aqueous or hydroalcoholic carrier. The resulting solution can be used in a pump spray, or can be pressurised by the addition of

an aerosol propellant in accordance with methods well known in the art.

EXAMPLE A

PREPARATION OF A CARBOXYLATED POLYURETHANE RESIN A

Polyoxyethylene diol having a number average molecular weight (M_n) of 8000 was heated under vacuum to 0.060% of water and 736 parts of the dried diol was added to 21 parts of diethylene glycol, 18 parts of dimethylolpropionic acid, and 2.84 parts of water. The mixture was heated with stirring until a homogeneous melt was obtained. Then, 139 parts of methylene biscyclohexyl-4-4'-diisocyanate were added. The NCO/OH ratio was 0.85. When the temperature reached about 64°C, 1.85 ml of dibutyltin dilaurate was added, and the mass was allowed to exotherm. The mass was heated at 100°C for about one hour to complete formation of the polymer. The polyurethane resin had a weight average molecular weight (M_w) of 76,000 and dissolved in a slightly basic 55/45 ethanol/water solution (wt/wt) at a concentration of 5 wt.% to give a viscosity of 18 cps. The polyurethane resin had an acid value of 7.75 mg KOH/g resin, and a kinematic viscosity of 14.7 cs in 55/42/3 ethanol/water/polymer solution by weight. The polyurethane resin was applied to the hair as a hair styling aid, and imparted excellent properties to the hair, such as a crust rating of 8.3, a feel of 9.6, a flaking rating of 8.4, a set retention of 94% at 85% relative humidity (RH) after 30 minutes, and a set retention of 91% at 85% relative humidity (RH) after 60 minutes.

EXAMPLE B

PREPARATION OF POLYURETHANE RESIN B

Polyoxyethylene diol having an M_n of 8000 was heated under vacuum to 0.215% of water, and 736 parts of the dried diol was added to 21 parts of diethylene glycol, 59 parts of dimethylolpropionic acid, and 1.81 parts of water. The mixture was heated with stirring until a homogeneous melt was obtained. Then, 168 parts of methylene bis-cyclohexyl-4-4'-diisocyanate were added. NCO/OH ratio was 0.65. When the temperature reached about 70°C, 1.85 ml of dibutyltin dilaurate was added, and the mass was allowed to exotherm. The mass was heated at 100°C for about one hour to complete formation of the polyurethane resin. The polyurethane resin had an M_w of 15,000 and dissolved in slightly basic 55/45 ethanol/water (wt/wt) solution at a concentration of 5 wt.% was clear and had a viscosity of 10 cps. The polyurethane resin had an acid value of 24.22 g KOH/g resin, and a kinematic viscosity of 4.60 cps in 55/42/3 ethanol/water/polymer solution by weight. The polyurethane resin was used as a hair styling aid to impart a superior soft feel, excellent set retention, low crust, and low flaking properties to treated hair. Polyurethane Resin B imparted a crust rating of 4.5, a feel of 4.5, a flaking rating of 1.8, a set retention of 85% at 85% RH after 30 minutes to treated hair.

EXAMPLE C

PREPARATION OF POLYURETHANE RESIN C

Polyoxyethylene diol having an M_n of 8000 was heated under vacuum to 0.060% of water, and 736 parts of the dried diol was added to 21 parts of diethylene glycol, 18 parts of dimethylolpropionic acid, and 0.96 part of water. The mixture was heated with stirring until a homogeneous melt was obtained. Then, 114 parts of methylene bis-cyclohexyl-4-4'-diisocyanate were added. The NCO/OH ratio was 0.85. When the temperature reached about 63°C, 1.85 ml of dibutyltin dilaurate was added, and the mass was allowed to exotherm.

The mass was heated at 100°C for about one hour to complete formation of the polyurethane resin. The polyurethane resin dissolved in slightly basic 55/45 ethanol/water solution (wt/wt) at a concentration of 5 wt.% was clear and had a viscosity of 14 cps. The polyurethane resin has an acid value of 8.01 mg KOH/g resin, and an M_w of 40,000. The polyurethane resin was used as a hair styling aid to impart superior soft feel, excellent set retention, low crust and low flaking properties to treated hair. Polyurethane Resin C imparted a crust rating of 4.9, a feel of 6.7, a flaking rating of 7, a set retention of 97% at 85% RH after 30 minutes, and a set retention of 95% at 85% RH after 60 minutes to treated hair.

EXAMPLE D

PREPARATION OF POLYURETHANE RESIN D

A batch of 13,147 parts of polyoxyethylene diol having an M_n of 8000 was added to a five-gallon electrically heated reactor and heated under vacuum to dry the glycol. The dried diol was added to 368 parts of diethylene glycol and 321

parts of dimethylolpropionic acid, and the mixture was heated to 105°C in order to melt the ingredients. The mixture was allowed to cool to about 175°F to about 185°F and the water level was analysed by Karl Fisher method as 0.0675%. Then, 19.41 grams of water was added to the mixture to bring the total water to 28.75 grams of water.

5 A separate reactor contained 2073 parts of methylene bis(cyclohexyl-4-isocyanate). To the diols was added 33.04 cc of dibutyltin dilaurate. Then the isocyanate was heated to about 110°-115°F, and both liquids were forced out under nitrogen pressure using a piston cylinder at about a ratio of 0.1492. Twelve shots of liquid were pumped into a polypropylene tub and heated for one hour at 100°C. The NCO/OH ratio was 0.85.

10 The polyurethane resin was dissolved at 3 wt.% solids in 55/45 ethanol/water solution (wt/wt) and gave viscosities of 11 cps using a Brookfield viscometer. The polyurethane resin had a kinematic viscosity of 7.67 cps in 55/42/3 ethanol/water/polymer solution by weight. The polymer has an M_w of 40,000, and was very similar to Polyurethane Resin C.

The Polyurethane resin was used as a hair styling aid to give hair a superior soft feel, excellent set retention, low crust, and low flaking properties to treated hair.

15 To demonstrate the hair styling mousse compositions of the present invention, several aerosol compositions containing about 10% VOC (i.e., VOC is the sum of lower alcohol and propellant in the mousse composition) were prepared. Each composition contained 10% by weight of a propellant blend containing 70% hydrofluorocarbon 152a and 30% butane by volume. The mousse compositions were free of a lower alcohol. In some mousse compositions, the carboxylated polyurethane resin was the sole hair styling aid. In other compositions, an optional second hair fixative resin was present in addition to the carboxylated polyurethane resin. The compositions are summarised below as Examples 1-8 in Tables 1 and 2.

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TABLE 1

Example	1	2	3	4	5
Ingredients:					
Deionised Water	87.48 ¹	87.80	87.30	87.62	87.80
Polyurethane Resin A ²	1.00	1.00	1.00	1.00	--
Polyurethane Resin C ³	--	--	--	--	1.00
AMP ⁴	0.10	0.10	0.28	0.28	0.10
CELQUAT L200 ⁵	1.00	1.00	--	--	1.00
AMPHOMER ⁶	--	--	1.00	1.00	--
TAURANOL 78 ⁷	0.20	--	0.20	--	--
Lauramide DEA	0.02	--	0.02	--	--
Isosteareth 10	0.10	--	0.10	--	--

TABLE 1

Example	1	2	3	4	5
Ingredients:					
Fragrance	0.10	0.10	0.10	0.10	0.10
Propellant Blend ^a	10.00	10.00	10.00	10.00	10.00
Foam	Very Creamy	Creamy	Very Creamy	Creamy	Very Creamy
Foam Breaking	Very slow	Slow	Fast	Very Fast	

1 expressed as % by weight of the composition;
 2 the carboxylated polyurethane resin of Example A;
 5 3 the carboxylated polyurethane resin of Example C;
 4 2-amino-2-methylpropanol, available from Angus Chemical
 Co., Northbrook, IL;
 10 5 polyquaternium-4, a copolymer of hydroxyethylcellulose
 and diallyldimethyl ammonium chloride, available from
 National Starch and Chemical Corp., Bridgewater, NJ;
 15 6 octylacrylamide/acrylates/butylaminoethyl methacrylate
 copolymer, available from National Starch and Chemical
 Corp;
 7 sodium cocoyl isethionate, available from Finetex, Inc.,
 20 Elmwood Park, NJ; and
 8 butane (30% by volume) and hydrofluorocarbon 152a (70%
 by volume).

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 The hair styling mousse compositions of Examples 1-5 were prepared by warming the deionised water to about 60°C. Then, with agitation, the carboxylated polyurethane resin and the AMP were added to the warm water. When the mixture was homogeneous, the mixture was cooled to room temperature, followed by the addition of CELQUAT L200 or AMPHOMER. The resulting mixture was stirred until homogeneous, then the remaining ingredients were added with stirring. The resulting solution was added to a container, which was crimped, and then charged with the propellant blend.

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 The data summarised in Table 1 shows that a present mousse composition generates a consumer acceptable foam, even when the mousse composition is free of a foaming surfactant, i.e., Examples 2, 4 and 5. The presence of a foaming surfactant in Examples 1 and 3 merely provides a creamier foam. The amount of foam and the foam quality of mousse compositions containing a foaming surfactant and mousse compositions free of a foaming surfactant are comparable.

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 Table I also illustrates that a carboxylated urethane resin can be used in conjunction with an optional second hair fixative resin to provide a useful hair styling mousse composition. In particular, the mousse compositions of Examples 1, 2 and 5 incorporate a cationic second hair fixative resin (i.e., CELQUAT L200), and the compositions of Examples 3 and 4 incorporate an anionic second hair fixative resin (i.e., AMPHOMER).

The presence of an optional second hair fixative resin did not adversely affect the ability of the carboxylated polyurethane resin to generate a foam, even in the absence of a foaming surfactant.

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 Table 1 further shows that foam breaking properties can be adjusted from very slow to very fast, depending on the carboxylated polyurethane resin, the optional second hair fixative resin, and the amount of AMP present in the mousse composition, and on the presence of foaming surfactants in the hair styling mousse composition.

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 Table 2 summarises the hair styling mousse compositions of Examples 6-8, which were prepared using a commercial carboxylated polyurethane resin. The mousse compositions of Examples 6-8 were prepared in an essentially identical manner as the compositions of Example 1-5. The carboxylated polyurethane resin used in Examples 6-8 is a copolymer of polyvinylpyrrolidone and a polyurethane, showing that carboxyl group of the carboxylated polyurethane resin can be a carboxylic acid group or an ester group.

Table 2			
Example/Ingredients	6	7	8
Deionised Water	73.07 ¹	58.10	74.91
PECOGEL H-12 ¹	14.97	30.01	14.95
BRIJ-30 ¹⁰	1.80	--	--
BRIJ-700 ¹¹	--	1.76	--
Mineral Oil	0.14	0.13	0.14
A-31 Propellant ¹²	10.02	10.00	10.00
Foam Density (g/cc)	0.0310	0.0468	0.0470
Viscosity (cp)	28	40	26
pH	7.90	7.81	7.00
Foam Quality	Creamy, rich, breaks slowly	Stiff foam, grows, breaks slowly	Creamy, rich, crackling, breaks quickly
Dry Film Quality	Cloudy, waxy, soft	Grainy, waxy, soft	Clear, hard
Hair Set Retention (1 hr., 85% RH)	Poor	Poor	Better than control

PECOGEL H-12 is a 12% wt. ester polyurethane, available from Phoenix Chemicals Inc., Somerville, NJ;

Laureth-4, available from ICI Americas, Inc., Wilmington, DE;

Steareth-100, available from ICI Americas, Inc., Wilmington, DE; and

Isobutane

The data summarised in Table 2 shows that a hair styling mousse composition having consumer-acceptable foam quantity and quality can be provided by a carboxylated polyurethane resin having ester carboxyl groups, even when a foaming surfactant is excluded from the composition (i.e., Example 8) and a defoaming component (i.e., mineral oil) is present in the composition. The mousse compositions also had a low viscosity making application to the hair by rubbing with the fingertips easy and efficient.

Table 2 also illustrates that preferred embodiments of the present invention do not incorporate a foaming surfactant into the hair styling mousse composition. In particular, Example 8 shows that a mousse composition containing a carboxylated polyurethane resin and free of a foaming surfactant, produces a foam density (0.047 g/cc) and foam quality comparable to FINESSE MOUSSE, a commercial product available from Helene Curtis, Inc., Chicago, IL, and having a foam density of 0.045 g/cc. The mousse composition of Example 8 generates a foam that is equal in amount, and better in quality, than the foam generated by the mousse composition of Example 7, which incorporates a foaming surfactant. In preferred embodiments, a hair styling mousse composition of the present invention is free of a lower alcohol, and generates a foam density of at least 0.047 g/cc, i.e., 0.047 to about 0.06 g/cc.

The compositions of Examples 6 and 7, which incorporate a foaming surfactant, also provided a waxy, soft film on the hair that failed to provide good hair set retention. In contrast, the composition of Example 8, which is free of a foaming surfactant, provided a clear hard film on the hair. The mousse composition of Example 8 not only provided a better dry film quality than the mousse compositions of Examples 6 and 7, but also provided a hair set retention comparable to a control mousse composition containing AMPHOMER as the hair fixative resin. The hair set retention provided by the mousse composition of Example 8 is improved because Example 8 is free of surfactants. Surfactants plasticise dry resinous films left on the hair, which adversely affects the hair retention properties of the resin. Accordingly, it was observed that a foaming surfactant can impede the ability of the carboxylated polyurethane resin to provide a protective film on the hair, and, therefore, can adversely affect hair set retention because the highly hydrophilic nature of the foaming surfactants attracts water, plasticizes the resin, and helps destroy the hair set.

Examples 1-8 in Tables 1 and 2 further show that hair styling mousse compositions containing a carboxylated polyurethane resin and an optional second hair fixative resin, and having a low VOC (i.e., 10% by weight propellant and free of a lower alcohol) and a low viscosity, can be prepared. The second hair fixative resin is sufficiently solubilised, or dispersed, in the water, and, after the foam is broken, the hair styling mousse composition has a sufficiently low viscosity for easy and uniform application to the hair.

Experiments also were performed which duplicate air drying of a hair styling mousse composition after application to the hair. It was found that a carboxylated polyurethane resin, or a mousse composition of the present invention, gels within one hour after application to the hair. In contrast, a composition containing only AMPHOMER, i.e., a standard hair fixative resin in the art and used as a control, did not gel after air drying for two hours. Furthermore, hair treated with a hair styling mousse composition had a soft, natural feel and appearance, without excessive flaking or crust. In particular, the hair crust test measures the hardness and/or stiffness of hair treated with a hair styling mousse composition. Hair styling mousse compositions that provide natural, or reduced, crusts are desired. The hair flaking test measures the amount of flakes or dust that form on the hair after combing hair that has been treated with the mousse composition and dried.

In addition, hair set retention tests were performed. Set retention tests measure the ability of a hair styling mousse composition to hold or retain a hair style for an extended time at a particular relative humidity. Set retention is measured by applying 0.5 cc (cubic centimetre) of the hair styling mousse composition to a one gram hair tress, and testing six

or more tresses per composition. The sprayed tresses were allowed to dry overnight, at 30% relative humidity, in a zigzag shape. The tresses were hung inside a humidity chamber at 25°C and a predetermined relative humidity (i.e., 85% RH). The relaxed length was recorded of the tresses and set retention was calculated using the equation:

$$\% \text{ Set Retention} = (L - L_t) / (L - L_0) \times 100,$$

wherein L is the length of the fully extended tress, L_0 is the length of sprayed hair before relaxation, L_t is the length after exposure for a time, t.

The hair set retention results were compared to the results provided by a negative control containing only water. The comparative test shows that hair styling mousse compositions containing a carboxylated polyurethane resin and a second hair fixative resin (i.e., GANTREZ A425, a partial butyl ester of a copolymer of vinyl methyl ether and maleic anhydride, available commercially from ISP, Wayne, NJ) performed essentially as well as a hair spray composition containing only AMPHOMER. Such results are good because AMPHOMER is the hair fixative resin used in successful commercial hair styling mousse compositions.

Another important property of a present hair styling mousse composition is the ability to wash the hair setting resins from the hair, and thereby avoid polymer build-up on the hair. In accordance with an important feature of the present invention, the carboxylated polyurethane resin and the second hair fixative resin used in the hair styling mousse composition can be removed from the hair by simply shampooing the hair. The unexpected washability of the hair styling mousse composition is attributed to the acid value of the carboxylated polyurethane resin is at least about 7 mg KOH/g of resin, the polyurethane resin can be rinsed from the hair during shampooing without the need to neutralise the resin with an organic base.

The acid value is an indication of the number pendant carboxylic acid groups on the polyurethane resin backbone. Although noncarboxylated polyurethane resins are hydrophilic, they are difficult to wash from the hair in a short time. Washability is enhanced by incorporating pendant carboxylic acid groups onto the polyurethane backbone.

The effect of acid value is illustrated by Polyurethane Resins B and C, which show that washability is independent of M_w or R-value, but requires a carboxylated polyurethane resin having an acid value of about 7 mg KOH/g of resin or greater, e.g., about 7 to about 50 mg KOH/g resin. In particular, Polyurethane Resin A has an R-value of 0.86, an M_w of about 76,000 and an acid value of 7.75. Polyurethane Resin B has an R-value of 0.65, an M_w of about 15,000, and an acid value of 24.22. Polyurethane Resin C has an R-value of 0.85, an M_w of about 40,000, and an acid value of 8.01. Polyurethane Resins A, B and C each are washable from hair because each has an acid value of at least 7 mg KOH/g of resin.

The acid value was measured by titrating a solution of the resin with potassium hydroxide. The acid value is expressed in milligrams of KOH per gram of carboxylated polyurethane resin. The washability of the resin was determined by applying 3 wt.% solution of polyurethane resin onto clean, 2 gram, 6-inch long hair tresses, allowing the hair to dry, then washing the hair tresses with shampoo and warm water for about 3 minutes.

Claims

1. A hair styling mousse composition comprising:

(a) from 0.25% to 6% by weight of a carboxylated polyurethane resin,

(b) optionally, up to 6% by weight of a second hair fixative resin.

(c) optionally, up to 20% by weight of a lower alcohol; and

(d) from 15% to 99.5% by weight of a carrier comprising water.

in which the carboxylated polyurethane resin has a weight average molecular weight of 10,000 to 150,000.

2. A composition according to claim 1 further comprising from 3% to 30% by weight of a propellant.

3. A composition according to claim 1 or 2 which is free of a foaming surfactant.

4. A composition according to any preceding claim in which the carboxylated polyurethane resin comprises a reaction product of a mixture comprising:

(i) 10% to 90% by weight of the mixture of a polyoxyalkylene diol having a number average molecular weight of 200 to 200,000;

(ii) 0.01% to 20% by weight of the mixture of an alkylene glycol;

(iii) 3% to 80% by weight of the mixture of an organic diisocyanate;

(iv) 1% to 8% by weight of the mixture of a 2,2'-di (hydroxymethyl)alkanoic acid; and

(v) 0.05% to 0.5% by weight of the mixture of water,

wherein the ratio of isocyanate groups to hydroxyl groups is from 0.5 to 1.

5. A composition according to claim 4, in which the polyoxyalkylene diol is selected from the group consisting of polyoxyethylene diols having a number average molecular weight of from 200 to 20,000, polyoxypropylene diols having a number average molecular weight of from 200 to 2,500, polyoxytetramethylene diols having a number average molecular weight of from 200 to 4,000, block copolymers of ethylene oxide and propylene oxide having a number average molecular weight of 1,000 to 9,000, and mixtures thereof.
6. A composition according to claim 4 or claim 5, in which the organic diisocyanate is an aliphatic diisocyanate.
7. A composition according to any one of claims 4 to 6, in which the 2,2-di (hydroxymethyl) alkanoic acid comprises dimethylolpropionic acid.
8. A composition according to claim 1, in which the carboxy groups of the carboxylated polyurethane resin comprise carboxylic acid groups, ester groups, or a mixture thereof.
9. A composition according to claim 1, in which the carboxylated polyurethane resin comprises a PVP/polycarbamyl polyglycol ester.
10. A composition according to any one of claims 1 to 9 which is free of a neutralizing agent for the carboxylated polyurethane resin.



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 6137

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE 42 25 045 A (BASF AG) * claim 1: examples D,E *	1	A61K7/06
P.X	EP 0 734 717 A (BASF AG) * claim 1: example 2 *	1	
A.F	EP 0 745 373 A (L'OREAL)	1	
A.D	EP 0 619 111 A (NATIONAL STARCH AND CHEM. CO.) [U.S. Pat. 5,400,000]	1	

TECHNICAL FIELDS
SEARCHED (Int.Cl.6)

A61K

The present search report has been prepared by the following:

THE HAGUE

16 February 1998

Glikman, J-F

CATEGORY OF RELEVANT DOCUMENTS

- 1. can be used as a reference
- 2. can be used as a starting point for further research
- 3. can be used as a starting point for further research
- 4. can be used as a starting point for further research
- 5. can be used as a starting point for further research
- 6. can be used as a starting point for further research

- 7. can be used as a starting point for further research
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